REMARKS

By the present amendment, claims 1, 2, 4 to 6 and 14 to 26 are pending in the application.

Amendments to the Specification

The specification has been amended at page 43 and page 46 to correct readily apparent typographical errors.

At page 43, line 5 of the specification as originally filed, Table 7 does not set forth steel compositions. Table 1 sets forth the steel compositions. The steel compositions of Table 1 (Page 31) are examples 1 to 10. The steel compositions of Table 2 (page 35) are examples a to y. Therefore page 43, line 5 is clearly referring to example No. 2 of Table 1.

The same applies with respect to page 46, line 5 of the specification as originally filed. Table 8 does not set forth steel compositions.

§112, ¶ 12

Claims 1-13 were rejected under 35 U.S.C.§112, second paragraph, as being indefinite.

In response to this objection the claims have been amended by the present amendment.

In view of the present amendment, it is respectfully requested that the rejections under 35 U.S.C.§112, second paragraph, be withdrawn.

Claim 1

Claim 1 has been amended to specify that the oxides occupying 5 to 80% of the surface area of the steel sheet are - -Si, Mn and Al - - oxides. Support for this amendment may be found in original, now cancelled, dependent claim 3.

Claim 1 has been further amended to specify that the 5 to 80% surface area of the steel sheet occupied by the Si, Mn and Al oxides is on the surfaces of the steel sheet

interfacing with the hot-dip plating layer prior to the hot-dip plating layer by dissolved by fuming nitric acid.

The present invention is directed to a hot-dip galvanized steel sheet having a high tensile strength, no non-plated portions and excellent surface appearance for a steel sheet containing relatively large amounts of Si, Mn and Al in the composition of the steel sheet. See, e.g., specification, page 8, lines 12 to 21. The prior art considered Si, Mn and Al in the composition of the steel sheet to be detrimental to plating performance, i.e., plating appearance and plating adhesiveness. See, e.g., specification, page 1, lines 12 to 16.

In the present invention, plating performance (plating appearance and plating adhesiveness,) is obtained by intentionally forming oxides on the steel sheet surface which results in suppressing the incrassation of Si, Mn and Al in the surface layer of the steel sheet. See, e.g., specification, page 15, line 23 to page 16, line 13.

It would therefore be readily understood by one skilled in the art that Si, Mn and Al oxides are present on the surface of the steel sheet prior to the hot-dip plating layer being dissolved by fuming nitric acid. It would be readily understood by one skilled in the art that the Si, Mn and Al oxides are not caused by the nitric acid treatment or ambient exposure because such Si, Mn and Al oxides formed after planting could not improve plating adhesive and plating appearance.

Claim 5

Dependent claim 5 has been amended to be dependent on claim 1 and specifically recited the Mo concentration of claim 4 and recite the Ni and Cr concentrations of dependent claim 2 from which claim 4 depends. Dependent claim 5 has also been amended to positively recite the presence of retained austenite in the steel sheet.

Claim 6

Dependent claim 6 has been amended to be dependent on claim 1 and specifically recite the Mo, Cu and Sn concentrations of dependent claim 4 and recite the Ni

and Cr concentrations of dependent claim 2 from which claim 4 depends. Dependent claim 6 has also been amended to positively recite the presence of retained austenite in the steel sheet.

Claim 14

New dependent claim 14 is a simplified version of prior, now cancelled, dependent claim 13 directed to Si, Mn and Al oxides.

Claim 15

New independent claim 15 is based upon prior dependent claim 7, as dependent on dependent claim 5, rewritten in independent form.

Claim 16

New independent claim 16 is based upon prior dependent claim 7, as dependent on dependent claim 6, rewritten in independent form.

Claim 17

New dependent claim 17 is based upon the phrase "occasionally heat retention for 10 min. or less in said temperature range" appearing in dependent claim 7.

Claim 18

New independent claim 18 is based upon prior dependent claim 8, as dependent on claim 5, rewritten in independent form. The amount of iron in the hot-dip layer is specified as weight percent.

Claim 19

New independent claim 19 is based upon prior dependent claim 8, as dependent on claim 6, rewritten in independent form. The amount of iron in the hot-dip layer is specified as weight percent.

Claim 20

New dependent claim 20 is based upon the phrase "occasionally heat retention for 10 min. or less in said temperature range" appearing in dependent claim 8.

Claim 21

New independent claim 21 is based upon prior dependent claim 9, as dependent on claim 1, rewritten in independent form.

The phrase "O (30 ppm" has been replaced by --O $\leq$ 30 ppm--. See, Specification, Page 24, line 13.

Claim 22

New dependent claim 22 adds the chemical elements of dependent claims 2 and 4 to new independent claim 21.

Claim 23

New independent claim 23 is based upon prior dependent claim 10, as dependent on claim 2, rewritten in independent form with the Ni of dependent claim 2 positively set forth.

Claim 24

New dependent claim 24 is based upon original dependent claim 4 with the optional Cr of dependent claim 2 added.

Claim 25

New dependent claim 25 is directed to the optional chemical elements of dependent claim 4 which are not recited in the steel sheet composition of claims 15 and 18.

Claim 26

New dependent claim 26 is directed to the optional chemical elements of dependent claim 4 which are not recited in the steel sheet composition of claims 16 to 19.

§102

Claims 1 to 13 were rejected under 35U.S.C.§102(b) as being anticipated by WO 02/101112 to Fujita et al.

This rejection, as applied to the amended and new claims, is respectfully traversed.

The Present Invention

The present invention provides a 590-1080 MPa grade high strength hot-dip galvanized steel sheet and a method for producing the same. More particularly, a characteristic feature of the present invention is to appropriately control the hydrogen and oxygen concentration and dew point during annealing for obtaining an appropriate shape for the oxides formed on the steel surface in order to increase platability.

Improving plating adhesion depends on an interface between the plating layer and the surface of the steel sheet. That is, the surface area of more than 5% to less than 80% of the steel sheet must be covered by the oxides. This feature of the present invention is obtained by carrying out the processing steps of:

controlling the oxygen concentration: O (ppm) $\leq$50 ppm at the temperature of 400-750°C, and controlling the hydrogen concentration: H(%), dew point: D(°C), and the oxygen concentration: O (ppm), to satisfy the following expressions at the temperature range of more than 750°C for more than 30 seconds,

O (ppm) $\leq$30 pm

20xexp (0.1 x D) $\leq$H $\leq$2000 exp (0.1 x D) [independent claim 21];

or must be satisfied the following expression at the temperature range of more than 750°C for more than 30 seconds, in a relationship among the H, D, and Ni concentrations:

3 xexp {0.1 x (D+20 x (1-Ni (%))}$\leq$H $\leq$2000xexp { (0.1x(D+20 x (1-Ni (%))) } [independent claim 23].

Patentability

The technology disclosed in WO 02/101112 ("WO '112") relates to a high strength hot-dip galvanized and galvannealed steel sheet having fatigue resistance, corrosion

resistance, ductility and plating adhesion after severe deformation, and a method for producing the same. However, WO'112 discloses a different technology than the present invention regarding the improvement of platability.

WO'112 targets to regulate the microstructure of the interface between a plated layer and the steel layer to improve fatigue and corrosion resistance. An improvement to the platability is carried out, according to WO'112, by means of reduction of the Al concentration and adding certain amounts of the specific elements into the plating layer, as mentioned in the expressions of 1, 2, and 3, and further defining the relationship between the amounts of Mn, Al and Mo contained in the steel sheet, and the concentration of Al, Mn and Mo contained in the plating layer. Actually, this is carried out in WO'112 by changing the melt bath compositions and the plating layer compositions for increasing wetability, as shown in Examples 1-4.

Therefore, WO'112 does not disclose or suggest the oxides control on the surface of the steel sheet by means of controlling the atmosphere before plating step, which is the main feature of the present invention. Further, WO'112 clearly describes that fatigue and corrosion resistance properties are improved by means of controlling the depth of oxides phase at the grain boundary and the ratio of oxides at the cross-sectional area in the depth direction from the interface to 10μm.

On the other hand, the present invention defines the area ratio of oxides on the surface of the steel sheet at the interface between the plating and the surface of the steel sheet, which is quite different from the feature of controlling the depth of oxides phase at the grain boundary and the ratio of oxides at the cross-sectional area in the depth direction from the interface to 10μm as disclosed in WO'112. Therefore, the present invention is quite different from the technology disclosed or suggested in WO 02/101112.

It is therefore submitted that claims 1, 2, 4 to 6 and 14 to 26 are patentable over WO 02/101112 to Fujita et al.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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